Phase I
Site Assessment and Interim Remedial Measures Workplan
Tutu Texaco Station
Tutu, St. Thomas, U.S.V.I.

H+GCL
Environmental Scientists and Engineers

Phase I
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Tutu, St. Thomas, U.S.V.I.

November 9, 1993

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1.0 Executive Summary

On behalf of O'Connor and Lemos, P.A., H⁺GCL proposes to characterize the subsurface conditions at the Texaco Tutu service station and install wells required for implementation of an interim remedial measure (IRM). A two-phase field investigation will provide the data necessary to verify our opinion that the Texaco Tutu service station is not a source of subsurface chlorinated hydrocarbons observed in the area. This workplan addresses Phase I of our program. Phase II of the program will consist of work elements required for implementation of an IRM and will be developed after review of the results of the Phase I investigation.

The Phase I program consists of a series of borings, wells, and potential excavations in the areas of waste disposal/management and gasoline storage/management. Soil samples and groundwater samples will be obtained to measure any impact to groundwater quality from these areas.

Site characterization and quality assurance methods to be used for this project are consistent with the methods employed by Geraghty & Miller during previous investigations of the area. These Geraghty & Miller investigations were conducted pursuant to an Administrative Order on Consent with the United States Environmental Protection Agency (USEPA), and were subject to considerable scrutiny. We believe these methods are fully appropriate for this proposed program.

Project staff selected for the Texaco Tutu service station have experience on Resource Conservation and Recovery Act (RCRA) and Comprehensive Environmental Response and Compensation Liability Act (CERCLA) sites, and are well-versed in appropriate field protocol. Staff members from H⁺GCL's Albuquerque, New Mexico, and Lanham, Maryland offices will participate in the field programs. The program is scheduled for implementation in late November, after USEPA review of this work plan. A final report, detailing the results of this investigation and specific details regarding the IRM, will be issued by February 1994.

We will undoubtedly employ a phased approach to any interim remedial measure that is indicated from the data generated during the Phase I investigation. Initially we may utilize soil vapor extraction as the IRM. If free-phase hydrocarbons are encountered on the water table, appropriate product removal systems will be proposed.

2.0 Introduction

Based on data generated during previous investigations, which include the Geraghty & Miller Technical Memorandum II groundwater sampling report (ref. #13), aromatic hydrocarbons, and possibly phase-separated petroleum hydrocarbons have impacted the subsurface (both soils and groundwater) beneath the Texaco Tutu service station. H⁺GCL proposes the following site-specific investigation program in order to design an interim remedial measure for the Texaco Tutu site.

2.1 Purpose and Scope

The primary objective of this investigation is the installation of sufficient wells to implement an interim remedial measure (IRM) to remove petroleum hydrocarbons from the subsurface. Data to aid in the design of such an IRM system will also be collected.

The secondary objective of the Texaco Tutu site investigation is to obtain data to verify that site activities did not contribute to the observed chlorinated hydrocarbon groundwater plume in the Turpentine Run area. Site investigations at potential source areas, remediation of identified sources, and development of an integrated remedy for nearby drinking water supply wells (e.g., point of use treatment) depends upon a solid understanding of past and current contribution of contaminants from all suspected sources.

The tertiary objective of the site investigation is to better define the extent and magnitude of petroleum hydrocarbon contamination emanating from the Texaco Tutu site. Understanding how contaminants migrate from the Texaco Tutu site under past and present conditions is an important element in the design of an integrated remedial strategy for the Turpentine Run area (e.g., point-of-use treatment).

Several materials management units (e.g., underground storage tanks) and waste disposal units (e.g., oil/water separator, infiltration gallery, septic tank) on the Texaco Tutu site have had the potential to release petroleum hydrocarbons to groundwater. Additionally, off-site sources of these compounds and chlorinated solvents have also been identified. Therefore, influences of off-site sources at the Texaco Tutu site must also be understood if we are to meet our goals.

With these three objectives in mind, a proposed scope of work for the Texaco Tutu station has been developed and is included in Section 3.0. Section 4.0 provides specific investigation methodologies, while sections 5.0, 6.0, and 7.0 describe quality assurance and quality control measures, report preparation, and project schedule, respectively.

2.2 Site Description and History

The Texaco Tutu service station is located on St. Thomas, U.S. Virgin Islands (figure 1). It is at the northeast corner of the intersection of Route No. 38 and Route No. 348 in the Tutu Turpentine Run area (figure 2).

The history of the Texaco Tutu station is summarized in various reports (refs. #8, #11, #12, #18, #21). These references indicate that the Texaco Tutu service station has sold retail gasoline and performed minor automobile maintenance since 1964. Automotive maintenance operations began shortly after the station opened. Figure 3 shows the current configuration of the Texaco Tutu station.

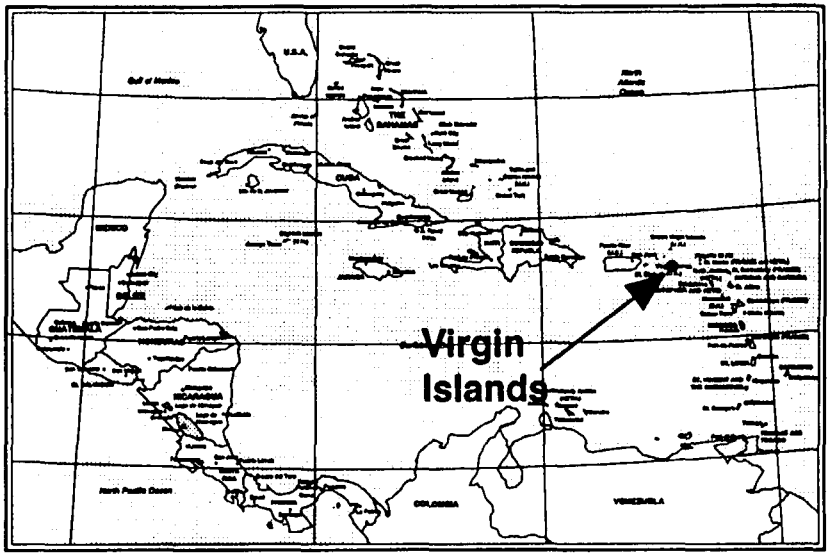
In July 1987, the owners of the Tillett water supply well, which is located approximately 500 feet south of the Texaco station (figure 2), reported an unusual odor in the well water. Subsequent sampling of the well and other supply wells by the USEPA Technical Assistance Team revealed the presence of volatile organic compounds (VOCs) in the well water. The detected compounds included gasoline constituents and chlorinated organic compounds. As a result, the USVI Department of Planning and Natural Resources (DPNR) closed 18 wells in the Tutu area from July to September of 1987. An Administrative Order on Consent (AOC), issued by USEPA and DPNR in September of 1987, ordered Texaco to investigate possible petroleum product releases.

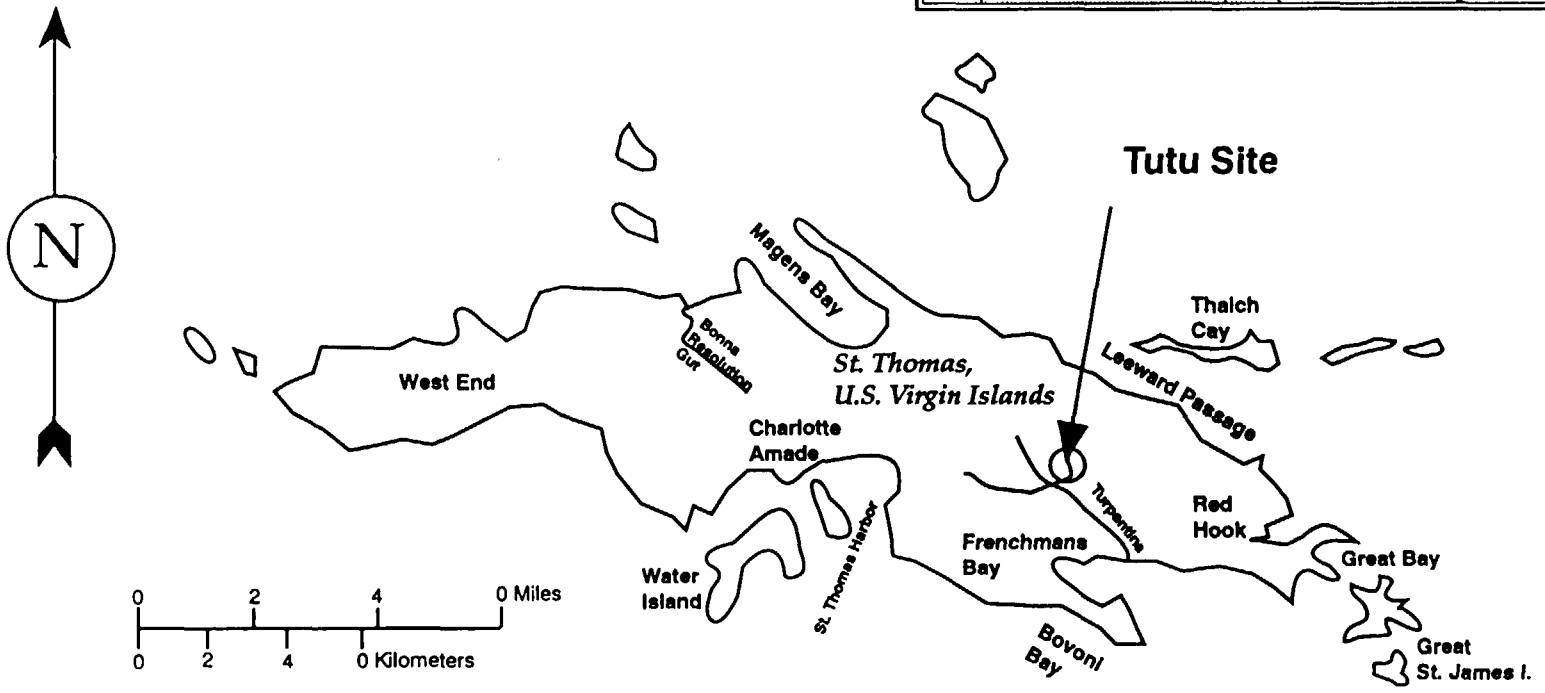
Geology and hydrology of the site is generally described in Geraghty & Miller Technical Memorandum II (ref. #13), a report issued in compliance with the AOC. Highly weathered and fractured volcanic and volcaniclastic rock underlies the site and comprises the uppermost section of the drinking water aquifer. Groundwater at the site is between 12 and 20 feet below ground surface and, under the present non-pumping conditions, flows generally to the south.

2.3 Materials and Waste Management

The station managed on-site wastewater with a system consisting of drains, an oil/water separator, septic tank and an infiltration gallery. Materials were stored in underground storage tanks and in a 55-gallon drum storage area. An NUS report also alleges that a second drum storage area existed at the site, although Texaco maintains only one such area existed as identified on figure 3. A description of each unit follows.

Figure 1
General Site Location
Texaco Tutu Service Station Investigation
St. Thomas, U.S. Virgin Islands





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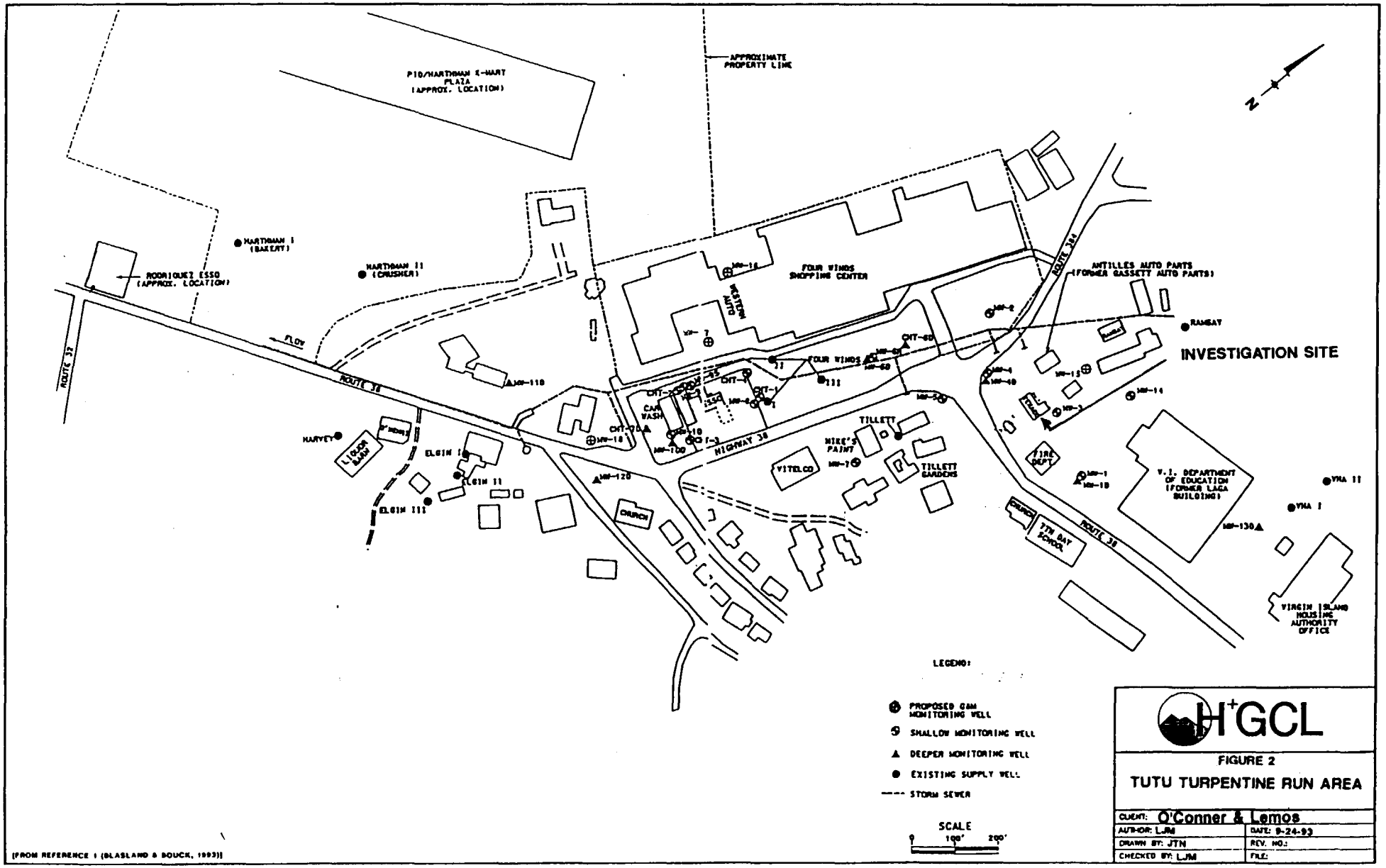

[FROM REFERENCE 1 (BLASLAND & BOUCK, 1993)]

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FIGURE 2

TUTU TURPENTINE RUN AREA

CLIENT: O'Conner & Lemos	
AUTHOR: LJM	DATE: 9-24-93
DRAWN BY: JTN	REV. NO.:
CHECKED BY: LJM	FILE:

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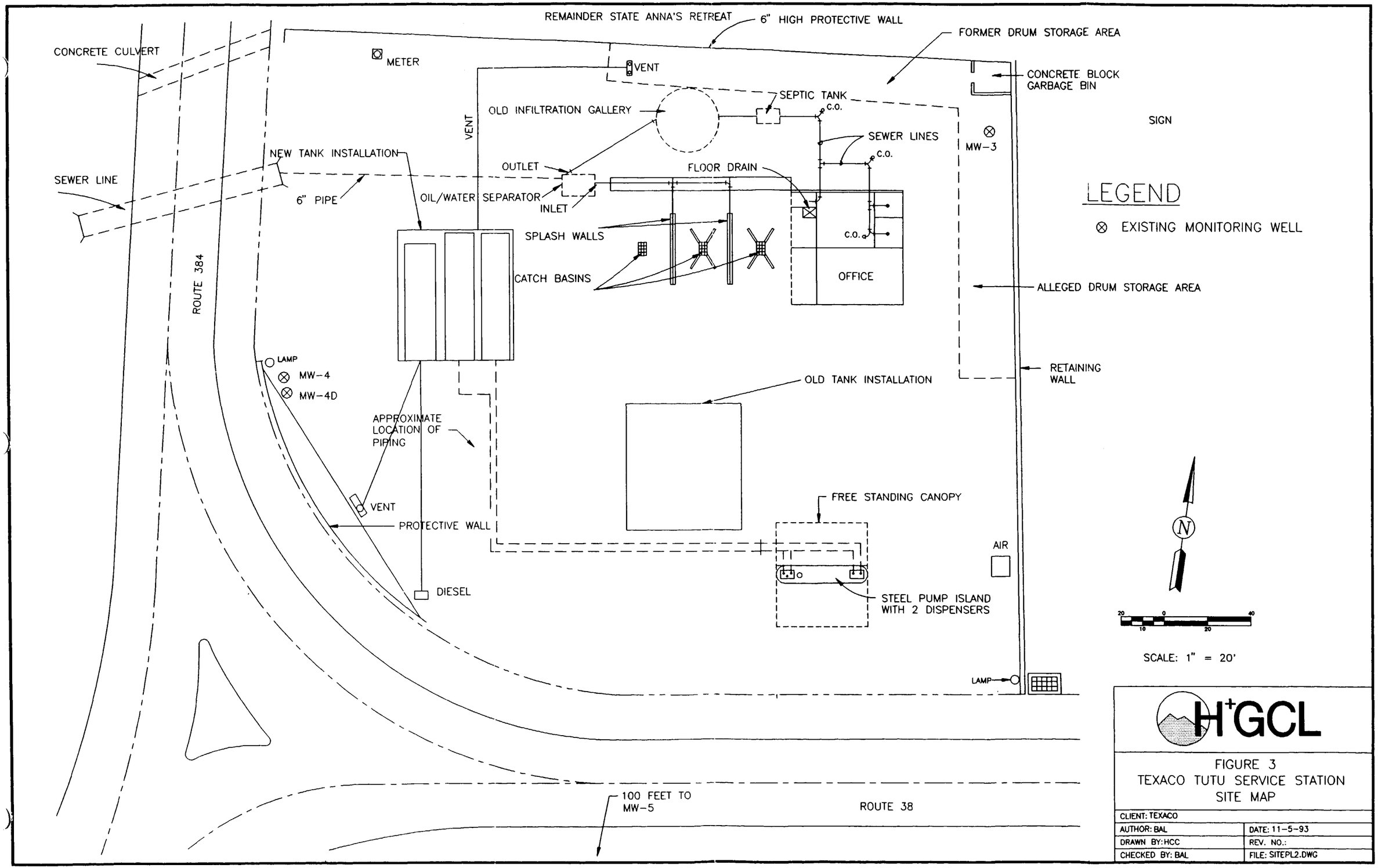

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FIGURE 3
TEXACO TUTU SERVICE STATION
SITE MAP

CLIENT: TEXACO	
AUTHOR: BAL	DATE: 11-5-93
DRAWN BY: HCC	REV. NO.:
CHECKED BY: BAL	FILE: SITEPL2.DWG

2.3.1 Underground Storage Tank Units

Three underground storage tanks (USTs) have been present at the facility since 1964 when the station opened. Fuel has been stored in USTs since the station opened, except for the period from August 1980 to September 1988 when one tank was out of service, and also for a short time in September 1988 when all three tanks and associated piping were removed and replaced.

The three original tanks were constructed of steel and were 6 feet 4 inches in diameter, 24 feet in length, with bases buried 8 feet 6 inches below grade. One tank stored regular gasoline; another stored unleaded premium gasoline, and the third stored regular unleaded. There are indications that the regular unleaded tank was removed from service in 1980, when possible leakage from this tank or attendant piping was identified. These tanks were removed and replaced in September of 1988 with two 12,000-gallon and one 6,000-gallon double-wall, steel tanks. The new tanks were placed north and west of the original tank field (figure 3).

The USTs at the Texaco Tutu service station have suspected and known releases of product to site soils and groundwater (ref. #19). While possible releases occurred prior to 1986, verified releases occurred in late 1986 and early 1987.

2.3.2 Oil/Water Separator

The Texaco Tutu site has one oil/water separator that is located on the northern portion of the site (figure 3). It is constructed with one baffle and two chambers to facilitate oil/water separation. The oil/water separator is a wire-reinforced concrete structure with a manhole cleanout. It is approximately 7 feet in length, 5 feet in width, and has a average depth of 7 feet. The unit has an approximate operating capacity of 1,450 gallons. The separator receives effluent from three catch basins in the service bays. Outflow from the oil/water separator was apparently directed to the infiltration tank present on the site. In January or February 1992 the outflow from this unit was plumbed into an existing sanitary sewer that runs adjacent to the property (ref. #25) and the unit is presently out of service.

Service station personnel indicate that until 1985 or 1986, waste oil generated on the site from automobile oil changes was disposed of directly into the oil/water separator. The contents of the separator were pumped out periodically by two local companies, H&M Systems and Majestic (ref. #1). After 1986, service station personnel indicated that waste oil was stored in drums (ref. #1).

2.3.3 Infiltration Gallery

The infiltration gallery was apparently designed to receive effluent (waste water) from both the oil/water separator and the service station septic tank (figure 3). The oil/water separator and the septic tank were plumbed to the sanitary sewer system in January or February of 1992 (ref. #25).

The infiltration gallery is a circular, rock walled structure with a square manhole cleanout cover. It is approximately 12 feet in diameter, and has a maximum depth of 6.3 feet. The base of this unit was sand-lined to allow the effluent from the septic system and the oil/water separator to seep into the underlying soil. The infiltration gallery received waste oil in the past. All waste oil has been removed and the unit is no longer in service.

2.3.4 Septic Tank and Floor Drain

The septic tank is a wire-reinforced concrete box measuring 5 feet 4 inches in length, 3 feet 10 inches in width, and 6 feet 4 inches in depth; this unit has a manhole cover type cleanout. The approximate capacity of the septic tank is 400 gallons. The influent from this unit is from three restrooms in the northeastern portion of the office building; two restrooms are located in the northeastern corner of the building, and one restroom is located to the east of the easternmost service bay (figure 3, ref. #1). This bathroom also has one floor drain. The effluent from the restrooms is piped to the septic tank, which was piped to the infiltration gallery until January or February of 1992 when the septic tank was plumbed into the sanitary sewer system (refs. #25 and #28).

2.3.5 Service Bay Drains

Three service bay catch basins are located in the service bays at the Texaco Tutu site (figure 3). These basins, which are plumbed into the oil/water separator, are designed as catchments for service bay wash-down waste water. The basins have been plugged, preventing flow into the oil/water separator.

2.3.6 Drum Storage Area

55-gallon drums containing various wastes have been stored along the north side of the Texaco Tutu station in the past. In addition, drums may have been stored along the eastern property boundary. The known and alleged drum storage areas are shown on figure 3.

2.4 Previous Work

Due to the discovery of chlorinated solvents and hydrocarbons in nearby drinking water supply wells in 1987, an Administrative Order on Consent issued by the USEPA and the DPNR ordered Texaco to investigate possible product releases. In response, Texaco conducted numerous investigations on the property.

In 1987, a soil-vapor survey performed within and around the Texaco Tutu facility indicated that the facility is a likely source of a hydrocarbon release from on-site gasoline underground storage tanks. The results of this survey indicated that high levels of hydrocarbons existed in site soils adjacent to the USTs (ref. #12).

Petrotite tests were performed on the three Texaco Tutu USTs in June 1987. The petrotite tests detected a possible failure of two of the tank structures (ref. #3). All three tanks were excavated in September 1988. During the UST removal, soil samples were taken from the sides and bottom of the pit and analyzed for volatile and semi-volatile organics, metals, total petroleum hydrocarbons, and ignitability. Samples taken from the base of the excavation indicated that a release of an unknown volume had occurred from at least one of the tanks.

Waste oil samples were collected from five waste oil storage drums, the oil/water separator and the middle service bay catch basin on July 8, 1989 by Camp Dresser and McKee Federal Programs Corp. (CDM FPC) [refs. #7 and #24]. The results of the analyses performed on these samples are summarized in table 1.

A number of additional investigations, both site-specific and regional, have generated data regarding the Tutu Texaco station. These investigations include:

- Sampling of sumps, storm drains and tanks from gasoline stations and auto body shops in Tutu St. Thomas (ref. #18)
- A UST removal and soil sampling program implemented by Lebron Associates with findings reported in January 1990 (ref. #8)
- The Tutu Environmental Investigation Committee (TEIC) investigation with findings reported by Geraghty & Miller in Technical Memorandum II (ref. #13)

Other reports, correspondence, and depositions were utilized for the development of the Texaco Tutu Work Plan. These sources of information are referenced in the work plan and summarized in Section 9.0.

Table 1

Summary of Waste Oil Samples Collected at Texaco Tutu Service Station

Sample Location Sample Number Sample Date	O/W Separator eT-62 Sept., 1988	O/W Separator eT-02-01a July, 1989	Catch Basin eT-02-02a July, 1989	Drum eT-02-04a July, 1989	Drum eT-02-05a July, 1989	Drum eT-02-06a July, 1989	Drum eT-02-07a July, 1989
(results in ug/kg)							
Benzene	BDL	BDL	7,000 J	46,000 J	11,000 J	4,000 J	BDL
Toluene	140,000	340,000 J	76,000 J	490,000 J	130,000 J	110,000 J	24,000 J
Ethylbenzene	400,000	190,000 J	35,000 J	140,000 J	49,000 J	61,000 J	13,000 J
Xylene (total)	160,000	1,600,000 J	190,000 J	900,000 J	330,000 J	88,000 J	120,000 J
Methylene Chloride	BDL	BDL	BDL	BDL	BDL	BDL	3,800 J
Acetone	----	BDL	BDL	BDL	BDL	BDL	BDL
2-Hexanone	----	BDL	BDL	59,000 J	BDL	BDL	BDL
Tetrachlorethene	BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,1,1-Trichlorethane	BDL	BDL	BDL	BDL	BDL	3,900 J	BDL

BDL = Below Detection Limit

J = Estimated value due to dilution factor, identification of the compound is certain

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3.0 Site Investigation Scope of Work

To verify the impact of on-site activities performed at the Texaco Tutu service station on the environment, H⁺GCL proposes a detailed, phased, intrusive site investigation. As part of Phase I, five shallow soil borings (SB-1 through SB-5), four shallow monitor wells (TT-1, TT-2, TT-4 and TT-5), and two deep monitor wells (TT-1d, and TT-3d) will be drilled to meet the objectives outlined in section 2.1. Figure 4 shows the locations of the proposed investigation. Many of the proposed monitor wells will also serve as IRM wells. The following discussions outline the proposed scope of work for this first phase investigation. Specific tasks associated with the first investigative phase are summarized in table 2.

3.1 Unsaturated Zone Investigation

An evaluation of the soils near potential contamination sources is proposed. Field personnel will collect two soil samples from each of the soil borings (SB-1 through SB-5) using a hand-auger. These samples will be collected from 2.5 feet and 5.0 feet below grade (or auger refusal) and submitted for laboratory analysis. These soil borings are located in the areas of the current service bays and in the former drum storage area (figure 4). The oil/water separator, septic tank, and infiltration gallery will be inspected and underlying or adjacent soils will be sampled.

In addition, samples will be collected from the unsaturated soils encountered during drilling of the proposed soil borings and monitor wells. Soil samples from the six proposed monitor wells will be collected every 2.5 feet using a split-spoon sampling device from 2.5 feet below ground surface to 4 feet below the water table or sampler refusal is encountered (the thickness of soil mantle is expected to be variable across the site). Soil will be immediately placed in a container for field head-space analysis with a photoionization detector (PID). A second vial will be filled for potential laboratory analyses. If possible, samples submitted for laboratory analysis will include:

- Soil from the interval directly above the saturated zone
- Soil from the interval exhibiting the highest PID headspace reading

Throughout the program, an effort will be made to collect samples with similar lithology and grain size to facilitate comparison of chemical analyses. Fine-grained, sand-silt lithologies provide a more representative analytical sample than coarse-grained materials. Thus, we will collect sand/silt samples wherever possible.

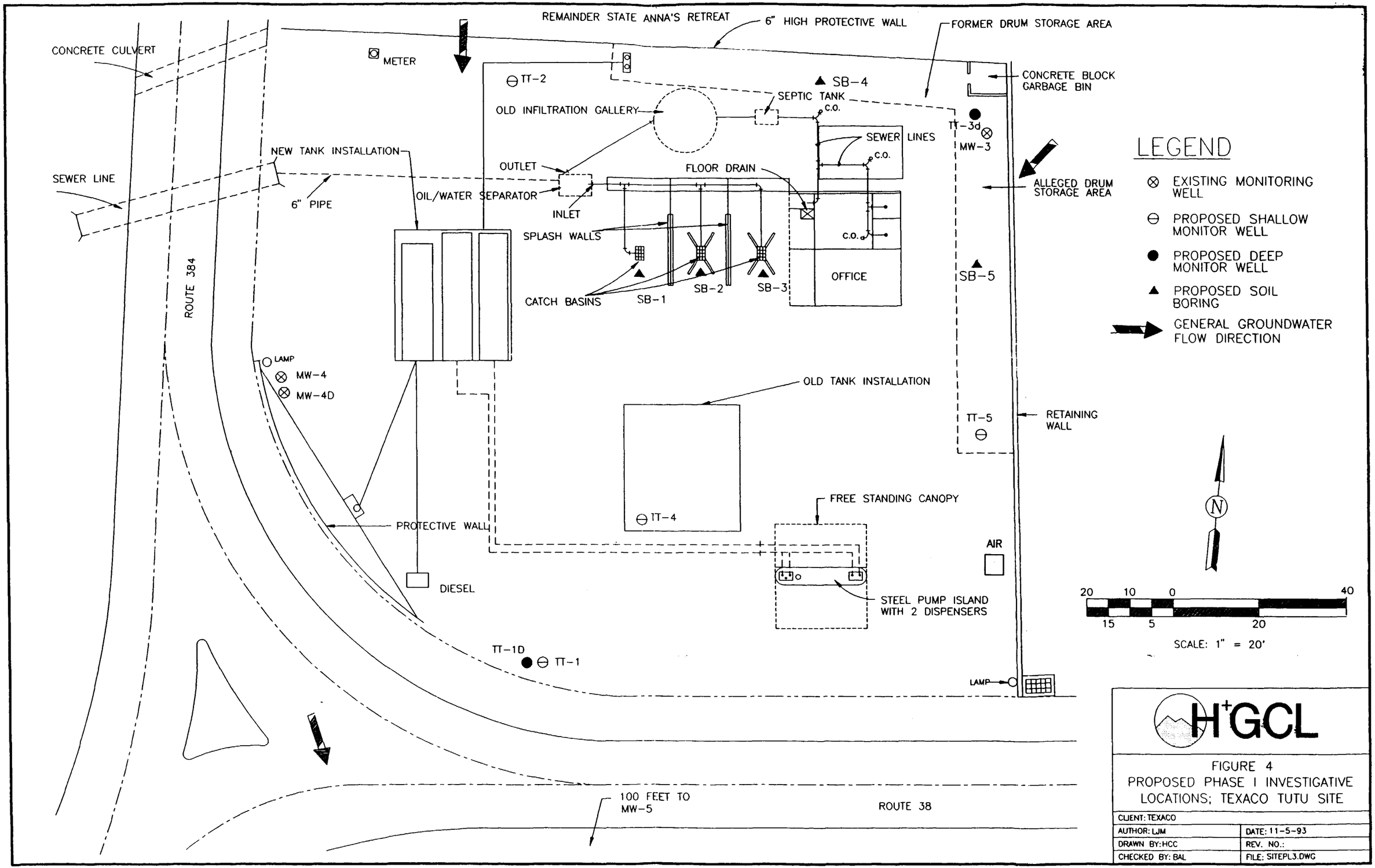

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FIGURE 4
PROPOSED PHASE I INVESTIGATIVE LOCATIONS; TEXACO TUTU SITE

CLIENT: TEXACO	
AUTHOR: LJM	DATE: 11-5-93
DRAWN BY: HCC	REV. NO.:
CHECKED BY: BAL	FILE: SITEPL3.DWG

Table 2

Tasks Associated with the Phase I Investigation
Texaco Tutu Site

Unsaturated Zone Investigation (soil borings)

Boring Number or Location	Soil Samples to be Collected Method 8240
SB-1	X
SB-2	X
SB-3	X
SB-4	X
SB-5	X
Septic Tank	X
Infiltration Gallery	X
Oil/Water Separator	X

Groundwater Monitor Wells

Well No.	Approx. Well Depth (feet bgs)	Casing Size (in.)	Screen Size (in.)	Soil Sampling Method 8240	Water Sampling Method 8240
TT-1	35	4" PVC	0.02	X	X
TT-1d	55	2" PVC	0.01	X	X
TT-2	35	4" PVC	0.02	X	X
TT-3d	55	2" PVC	0.01	X	X
TT-4	35	4" PVC	0.02	X	X
TT-5	35	4" PVC	0.02	X	X

Sample Summary

	Soils	Water*
Total Investigative Sample	28	12
Duplicates	3	2
Rinsates	2	1
Field Blanks	2	2
Trip Blanks	4	2

*Includes follow-up sampling event

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Soil samples collected during the investigation will be analyzed for volatile organic compounds (EPA Method 8240+xylenes).

3.1.1 Service Bay Drains and Catchment Basins

A shallow soil boring will be drilled with a hand auger or tripod-mounted unit adjacent to each catch basin (SB-1, SB-2 and SB-3 shown on figure 4) during the first phase of the investigation. Samples will be obtained at 2.5 and 5 feet below grade. Completion of these soil borings will determine if soil contamination has occurred through leakage from the service bays, floor drains, catchment basins, and/or piping associated with automobile maintenance and repair services performed at the Texaco Tutu station.

3.1.2 Drum Storage Area

Two borings are planned in the former known and suspected drum storage areas (SB-4 and SB-5) during the Phase I investigation. Samples from these borings will help determine if contamination associated with the drum storage area has affected the unsaturated zone.

3.1.3 Previous Underground Storage Tank Installation and Piping

The previously existing tanks at the Texaco Tutu site were removed in 1988 and tanks of larger capacity were placed in a different location north and west of the original tank field (figure 4). Field analysis (PID head-space) of soil samples from boring TT-4 will provide information concerning past releases from the original UST basin and the potential for hydrocarbon-contaminated soil at this location to act as a source of contamination to the underlying groundwater. It is anticipated that well TT-4 will be used for the interim remedial measure well. Soil samples will be collected from this location as described in section 3.1.

3.1.4 Oil/Water Separator, Infiltration Gallery and Septic Tank

H⁺GCL proposes to empty the existing oil/water separator, infiltration gallery and septic tank, and steam-clean and inspect them for structural integrity. Soil samples will be collected directly beneath or adjacent to the base of each unit and submitted for laboratory analysis (Method 8240).

3.2 Saturated Zone Investigation

The principal reason for installing these wells is for use in the proposed IRM. Figure 4 shows the proposed monitor well locations and the general groundwater flow direction across the site as measured in November 1992. Wells scheduled for installation during the first investigative phase are shown on table 2.

The wells installed during Phase I will provide basic data needed to design the remedial system. Data from these wells will also help assess the on-site contribution of contaminants to the existing contaminant plume beneath the Tutu Turpentine Valley. The monitor/IRM well locations have been selected to delineate the horizontal extent and concentration of contaminants in groundwater beneath the site and to determine if contaminants were derived from up-gradient sources (figure 4).

Monitor wells will be drilled with an appropriate air hammer or rotary drill rig having sampling capabilities. Soil samples will be collected as described in sections 3.1 and 4.6.

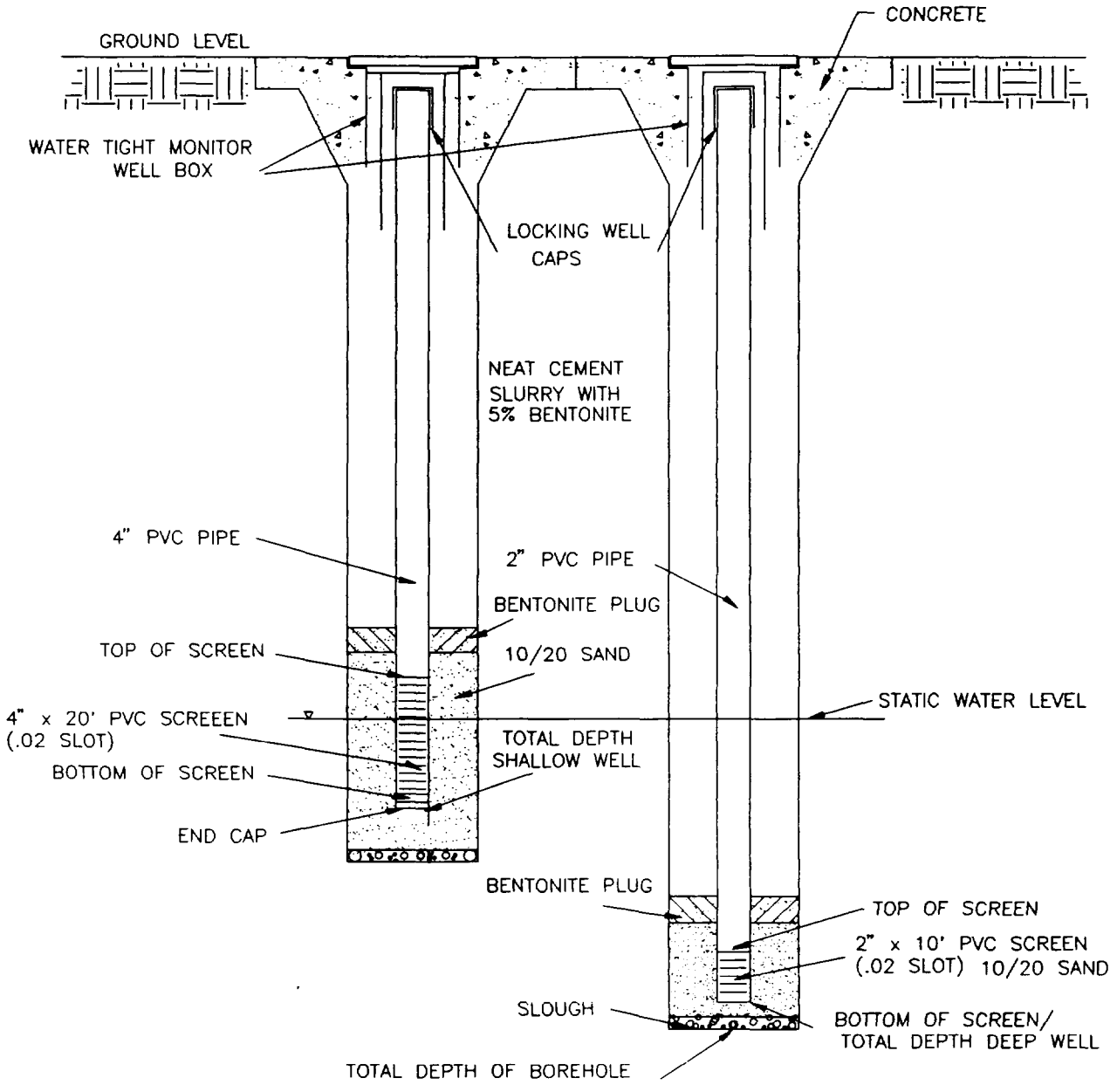
Groundwater samples collected during this investigation will be analyzed for volatile organic compounds (EPA Methods 8240+xylenes)(see table 2).

3.3 Well Construction

Based upon the assumption that the vertical extent of petroleum hydrocarbon contamination does exceed 30 feet below the water table (40 feet below grade) at this site, the following descriptions for well installation are presented.

3.3.1 Deep Monitor Wells

The deep monitoring wells (TT-1d and -3d) will be drilled, developed and sampled. Chemical data from the wells will provide information on the vertical contaminant plume configuration on the down- and up-gradient sides of the site. The anticipated depth of these monitoring wells is approximately 55 feet below grade. These wells will be completed with 2-inch diameter PVC casing and screen. The screened interval will be 10 feet long at the bottom of the well. The specific location of the screened interval will be selected in the field based upon water production data. Generalized construction details are presented in figure 5.



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CLIENT: O'CONNER & LEMOS	
DATE: 11-5-93	REV. NO.: 1
AUTHOR: BKL	DRAWN BY: HCC
CK'D BY: RTH	FILE: DUALWL.DWG

FIGURE 5
WELL COMPLETION DIAGRAMS

3.3.2 IRM Wells

The proposed IRM wells (TT-1, TT-2, TT-4, and TT-5) will be drilled to an approximate depth of 35 feet below grade. These 4-inch PVC wells will be completed with a 20 foot, 0.02-slotted screen placed across the water table interface. These wells will be used as monitoring wells for site characterization and as vapor venting wells during the IRM. The deep wells (TT-1d and TT-3d) may be used for air injection during remedial activities if necessary. Existing wells MW-3 and MW-4 may be incorporated into the final IRM.

3.3.3 IRM Well Sampling

Groundwater from the proposed monitor wells on the Texaco Tutu site will be sampled following monitor well development. The wells will be re-sampled to confirm the initial sampling event results.

4.0 Field Investigation Procedures

H+GCL will employ USEPA-approved methods for conducting field investigations, as outlined in the Geraghty & Miller Sampling, Analysis, and Monitoring Plan for Wells (ref. #9) and Geraghty & Miller Tutu Service Station Investigation Work Plan (ref. #11). To produce reliable, defensible data, procedures will follow those outlined in the Geraghty & Miller Quality Assurance Project Plan (ref. #10). The following section provides brief, general descriptions of field procedures. The reader is referred to the Geraghty & Miller documents for detailed methods. This plan will be updated as required to accommodate all work elements of this program.

4.1 Health & Safety

All on-site personnel will adhere to strict health and safety measures outlined in the Health and Safety Plan. H+GCL will be using the Health & Safety Plan developed by Geraghty & Miller (ref. #9, appendix B). The Health & Safety Plan will be maintained at the site throughout the duration of the investigation for daily review. Personnel protection equipment (PPE) will include Level D modified equipment, such as hard hats, safety shoes, safety glasses, ear protection devices, and hand protection, as required to prevent contact with chemical contaminants. Should the continuous safety monitoring devices, such as the photoionization detector (PID) and combustible gas indicator (CGI), indicate that more protective measures need to be taken, the PPE will be upgraded.

4.2 Decontamination

Prior to commencing field work, all equipment will be thoroughly decontaminated. Decontamination procedures minimize the introduction of contamination into the borehole and cross-contamination between samples. All drilling equipment will be steam-cleaned using pressurized water heated to a temperature of 160° F or greater prior to down-hole use. The drilling contractor will construct a temporary decontamination pad at the site for this purpose. Sampling tools will be decontaminated with an Alconox, deionized water, and methanol wash method prior to use and in between sample runs. The submersible pump used for well development and sampling will be decontaminated between each well using an Alconox rinse followed by a minimum 10-gallon, clean-water pump cycle.

4.3 Drilling Methods

Drilling methods will follow those specified in the Geraghty & Miller Work Plan (ref. #11, appendices E and F). Subsurface conditions at the site dictate the need for air-hammer/ rotary drilling techniques.

After collecting the appropriate samples, field personnel will log the lithology for that interval. The minimum information included in the lithologic descriptions will include soil/rock type according to the Unified Soil Classification System (USCS); percentage of soil grain sizes, grain sorting, roundness, consolidation, stratification, soil color according to the Rock Color Chart distributed by the Geological Society of America; and any other distinguishing features. The lithologic description form will include a narrative description of the lithology, the percentage of soil recovered in each sampler, the field head-space measurement for each interval, and sample information. An example of the lithologic description form is shown in figure 6. Detailed methods are described in the Geraghty & Miller Work Plan (ref. #11, appendix B).

4.4 Monitor Well Development

Monitor wells will be developed in the same procedure as those specified in the Geraghty & Miller Work Plan (ref. #11, appendices E and F). All monitor wells will be fully developed as soon as the grout seal has cured. Thereafter, a submersible pump or similar device will be used for well development. Wells will be developed until the water is clear of sediment, and field parameters (pH, specific conductivity, and temperature) have stabilized according to H⁺GCL standard operating procedures for well development. Water added during drilling activities will be removed from the well during development. Well development field data, such as pre- and post- development water levels, type and capacity of pump, field parameters, physical characteristics of the water, and volume developed, will be recorded on H⁺GCL's well development form (figure 7). Groundwater samples will be collected for analysis after the wells are properly developed.

4.5 Sample Collection

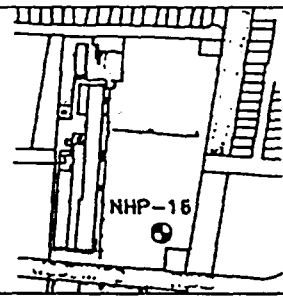
Methods for collecting soil and groundwater samples will follow those outlined in the Geraghty & Miller Work Plan (ref. #11, appendices B, G and I), and Geraghty & Miller Sampling, Analysis, and Monitoring Plan (ref. #9, appendices C and D). H⁺GCL will contract ENSECO Laboratories in Somerset, New Jersey (or an equivalent laboratory), to

LITHOLOGIC LOG DESCRIPTION FORM

FIGURE 6

NHP-16 LITHOLOGIC LOG

LOCATION MAP:



NOT TO SCALE

___1/4 ___1/4 ___1/4 ___1/4 S___ T___ R___

SITE ID: _____ LOCATION ID: NHP-16
SITE COORDINATES (ft.):
N 1473497.64 E _____
GROUND ELEVATION (ft. MSL): 4937.44
STATE: _____ COUNTY: _____
DRILLING METHOD: HSA CONTINUOUS CORE W/HYDROPUNCH
DRILLING CONTR.: _____
DATE STARTED: 6-21-93 DATE COMPLETED: 6-21-93
FIELD REP.: B. LANDIN
COMMENTS: _____

LOCATION DESCRIPTION: _____

DEPTH	WELL CONST.	LITH.	RUN #	RUN FROM	RUN TO	RECOV	SAMPLE TYPE	SAMPLE LD. OR READING	SAMPLE INTERVAL	LITHOLOGIC DESCRIPTION (LITH., USCS, GRAIN SIZE PROPORTIONS, WET COLOR, RNDG., SORT., CONSOL., DIST. FEATURES)
0			1	0	3'	2'	PID	0ppm		0-2.4' SAND W/SILT: 60% V. FN AND FN. GRAINED, 30% MED. COARSE SAND W/PEBBLE GRAVEL AND COBBLES, 10% SILT. VISIBLE MICA FLAKES. MOD.-POOR SORTED, UNCONSOL., UNSTRATIFIED, SUBRND. COBBLES UP TO 3" IN DIAMETER. SUBARKOSIC, MOIST, MOD YELL BRN 10 YR 5/4.
			2	3'	8'	5'	PID	0ppm		
5										2.4-7.5 SILTY CLAY: W/FN. SAND. LOW PLASTIC, FAIRLY DRY, 30% SILT AND V. FN. SAND, DUSKY YELL BRN 10 YR 2/2. ORGANICS. INC. IN SAND TO 40% FROM 3' TO 5', THEN BECOMES CLAYERIER, LOW TO MOD. PLASTIC. CALICHE NODULES AT 5 TO 7' (WHITISH).
			3	8'	13'	3'	PID	0ppm		
10										7.5-10' SAND: W/SILT AND CLAY. CONTACT IS GRADATIONAL, UPPER CONTACT HAS APPROX. 20% SILT AND CLAY. SAND IS V. FN. TO FN. W/SOME MED., MOD. SORTED, SUBANG., MOIST. PALE YELL BRN 10 YR 6/2 TO GRAYISH BRN. SILICA-RICH.
			4	13'	15'	2'	PID	0ppm		
15			5	15'	20'	5'	PID	0ppm		10-13' SAND: SIMILAR TO ABOVE BUT COARSER. 75% MEDIUM, 10% FN AND V. FN., 15% COARSE AND GRAVEL SIZE. MOD TO POORLY SORTED, UNSTRATIFIED, GRAVEL ZONES AT 11' AND 13', ANGULAR TO SUBRND. UP TO 1.5" DIAMETER. SILICA-RICH. OVERALL COLOR IS GRAYISH OLIVE, GRAYISH BRN. ABUND. CLEAR SILICA AND BLK VOLCANICS.
20			6	20'	25'	1.2'	PID	0ppm		13-18.5' SILTY CLAY: 20% SILT, LOW TO MOD PLASTIC, ORGANICS, ROOTS, CLAY IS PLATY, SLIGHTLY MOIST. REDDISH BRN, MOD. BRN 5 Y 3/4 TO DRK. YELL BRN 10 YR 4/2. MOISTURE INC. TO V. WET, HI PLASTIC CLAY AT 15.5'. V. THIN ZONE OF MOISTURE AT 17' CLAY BECOMES SILTIER W/FN. SAND (APPROX. 35') LOW PLASTIC, DRY, MINOR CALICHE.
25			7	25'	30'	2.2'	PID	0ppm		18.5-19.5' CLAYEY SAND: APPROX. 50/50 CLAY AND V. FN. SAND. DRY. MOD YELL BRN 10 YR 5/4 TO DRK. YELL BRN 10 YR 4/2. PARTIALLY CONSOLIDATED.
30			8	30'	35'	3.4'	PID	0ppm		19.5-25 SILTY CLAY: W/FN. SAND. 20% SILT AND V. FN. SAND. CLAY IS LOW TO MOD. PLASTIC, MOIST BUT NOT WET. POOR RECV. 20'-25'. CLAY IS DRK. YELL BRN. 10 YR 4/2.
35			9	35'	40'	0	PID	0ppm		25-29' SILTY CLAY: W/CALICHE (SCL)(CALICHE ONLY AT TOP). MOIST, HI PLASTICITY, APPROX. 10-15% SILT AND CALICHE GRAINS. TOP OF SCL IS APPROX. 25', DUE TO POOR RECOVERY, CONTACT IS UNKNOWN. AT APPROX. 29' (7 POOR RECOVERY) CLAY CHANGES FROM THE UNIFORM OLIVE GRAY, ORGANIC-RICH CLAY (SCL) TO A SILTIER, BRN CLAY. CONTACT IS UNKOWN DUE TO POOR RECOVERY. SCL HAS SM. WHITE SHELL FRAGS.
40										29-33.8' SILTY CLAY, CLAYEY SILT: APPROX. 40% SILT AND V. FN. SAND, MOD. TO HI PLASTIC, NO ORGANICS VISIBLE, COLOR IS MOD. YELL BRN. 10 YR 5/4. MOIST. SILT INC. W/DEPTH TO A CLAYEY SILT AT APPROX. 31'.
45										33.8-40' SANDY GRAVEL: V. POOR SORTING. SAND GRAINS VARY FROM FINE TO MED TO COARSE. 60% PEBBLE GRAVEL AND COBBLES UP TO 3" DIAMETER. SUBANG. TO SUBRND. SUBARKOSIC. VARIOUS COLORS BUT OVERALL MOD. YELL BRN 10 YR 5/4. SATURATED. VARIES BETWEEN COBBLY ZONES AND SANDIER ZONES.
50										

Page ___ of ___

MONITOR WELL DEVELOPMENT

WELL:

Date	Time	Method	Delta Volume (gallons)	Total Volume (gallons)	pH	T°C	Cond	Turbidity (NTU)	Initials	Comments

Water level pre-development: _____ post-development: _____

FIGURE 7

conduct the laboratory analysis of soil and groundwater samples collected during this investigation. Their laboratory methods and quality assurance project plan can be referenced in the Geraghty & Miller Quality Assurance Project Plan (ref. #10).

Soil and groundwater samples will be submitted for analysis by EPA Method 8240 (modified to include xylenes). Table 3 summarizes the analytes included in Method 8240. The number and type of samples expected to be collected during the Texaco Tutu investigation are summarized in table 2. Method 8240 is the preferred analytical technique that will allow more accurate distinction between chlorinated hydrocarbons and BTEX constituents.

Samples will be collected following strict chain-of-custody procedures to ensure the reliability and defensibility of the sample. An example of the chain-of-custody form to be used for all samples in included as figure 8.

4.5.1 Soil Samples

Soil samples will be collected every 2.5 feet from ground surface to the bottom of the unsaturated zone, or until bedrock is encountered using a sampling device. Field personnel will use decontaminated, stainless steel sample tools to immediately transfer the soil from the sampler into laboratory-prepared containers. No head-space will be left in the sample containers. These samples will be immediately placed on ice pending shipment to the laboratory. Section 3.1 describes which soil intervals will ultimately be selected for laboratory analysis.

Simultaneously, field personnel will fill a quart-sized mason jar half full for PID head-space analysis of the soil. The head-space samples will be shaken for 60 seconds and heated to approximately 60°F for analysis with the PID.

4.5.2 Groundwater Samples

Groundwater samples will be collected from each of the wells after they are fully developed. Field personnel will withdraw a minimum of three casing volumes of water from the well and monitor the field parameters for stability prior to collecting a groundwater sample. A typical groundwater sampling data sheet is shown in figure 9. Samples will be collected with a disposable polyethylene bailer and immediately poured into sample containers leaving no head-space and stored on ice. Detailed methods for collecting groundwater samples are described in the Geraghty & Miller Work Plan (ref. #11, appendix G and ref. #9, appendix C).

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6795

Chain of Custody

Date_____ Page_____ Of_____

Lab Name_____
Address_____
Telephone_____
Samplers (SIGNATURES)

Analysis Request

Sample Number	Matrix	Location	Halogenated Volatiles 601/8010	Aromatic Volatiles 602/8020	Phenols, Sub Phenols 604/8040	Pesticides/PCB 608/8080	Polynuclear Aromatic Hydrocarbons 610/8310	Volatile Compounds GC/MS 624/8240	Base/Neu/Acid Compounds GC/MS 625/8270	Total Organic Carbon (TOC) 415/9060	Total Organic Halides (TOX) 9020	Petroleum Hydrocarbons 418.1	TPH/BTEX Modified 8015	TCLP- Vol., Semi-Vol. Herbicides, Pesticides	TCLP- Metals	RCRA Metals(8)	Priority Pollutant Metals (13)	CAM Metals (18) TTLC/STLC	Flash Point	Corrosivity	Reactivity	Oil & Grease	Cyanide Total/Amenable	Chemical Oxygen Demand (COD)					Number of Containers

Project Information	Sample Receipt	
Project	Total No. of Containers	
Project Director	Chain of Custody Seals	
Charge Code No.	Rec'd Good Condition/Cold	
Shipping ID. No.	Conforms to Record	
Via:	Lab No.	

Special Instructions/Comments:

Relinquished By 1.	Relinquished By 2.	Relinquished By 3.
(Signature) (Time)	(Signature) (Time)	(Signature) (Time)
(Printed Name) (Date)	(Printed Name) (Date)	(Printed Name) (Date)
(Company)	(Company)	(Company)
Received By 1.	**Received By 2.**	**Received By (Laboratory) 3.**
(Signature) (Time)	(Signature) (Time)	(Signature) (Time)
(Printed Name) (Date)	(Printed Name) (Date)	(Printed Name) (Date)
(Company)	(Company)	(Laboratory)

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FIGURE 8

TUT 005 0339

FIGURE 9

DRAFT

Ground-Water Sampling Data Sheet

Page ____ of ____

Well ID_____ Date_____ Project_____

Project No._____ Samplers_____ Ground Elevation_____

TOC Elevation_____ Water Level (from north side, innerwell casing)_____

Well Depth (from TOC)_____ Casing Diameter (ID, ft.)_____ Material_____

Screened Interval (below surface)_____ Gallons/ft._____

Gals./ft. = [((casing diam. (ft)/2)^2 x π) x 7.48]

Casing Vol._____ x 3 = Purge Vol._____ Sample type (circle) Invest. Duplicate

Casing Vol. = (well depth (ft) - water level (ft)) x (Gals./ft.)

PID Reading (background)_____ Purging Method_____ Sampling Method_____

Discharge Water to_____ Condition of well_____

Comments:_____

Military Time HH:MM	Pumping Rate (GPM)	Cum Vol. of Water Removed Gals.	Cum Vol. of Water Removed Casing Vols.	PID Reading Locn.	PID Reading Value	pH	Temp. °C	EC umhos/cm	Comments
	Final Field Chemistry Measurements								

Total Volume Purged (Gallons):_____ Remarks:_____

Note: Field instrument calibrations must be logged in logbook prior to sampling.

Analytes	VOCs	Semi-Vols	Unfilt Metals	Filt Metals	Comments
Bottle Type	3x40 ml G	1x1 lit AG	1x500 ml P	1x500 ml P	
Preservative	HCl,pH<2	None	HNO3,pH<2	HNO3,pH<2	
Temperature	4 °C	4 °C	4 °C	4 °C	
Filtered	No	No	No	Yes	
Sample Number					
Duplicate Sample Number					
Total # Bottles					
CoC Form #					

PRIVILEGED WORK PRODUCT PREPARED IN ANTICIPATION OF LITIGATION

Signed: _____ Date: _____ GEWORK/SAMPDATA.FRM

TLIT 005 0340

Table 3
Volatile Organics-Analytes and
Detection Limits for U.S. EPA
Method 8240

ANALYTE	DETECTION LIMITS (ug/L)*
Chloromethane	10
Bromethane	10
Vinyl Chloride	10
Chloroethane	10
Methylene Chloride	5
Acetone	100
Carbon Disulfide	5
1,1-Dichloroethene	5
1,1-Dichloroethane	5
Trans-1,2-Dichloroethene	5
Chloroform	5
1,2-Dichloroethane	5
2-Butanone	100
1,1,1-Trichloroethane	5
Carbon Tetrachloride	5
Vinyl Acetate	50
Dichlorobromomethane	5
1,2-Dichloropropane	5
Trans-1,3-Dichloropropene	5
Trichloroethene	5
Bromodichloromethane	5
1,1,2-Trichloroethane	5
Benzene	5
Cis-1,3-Dichloropropene	5
2-Chloroethylvinyl Ether	10
Bromoform	5
2-Hexanone	50
4-Methyl-2-Pentanone	50
Tetrachloroethene	5
1,1,2,2-Tetrachloroethane	5
Toluene	5
Chlorobenzene	5
Ethylbenzene	5
Styrene	5
Xylenes (Total)	5

54153/ESSOTBL.WQ1

* Detection limits may vary due to matrix interferences.

4.5.3 Quality Assurance/Quality Control Samples

To ensure the reliability and integrity of all sampling data generated as part of this investigation, quality assurance/quality control (QA/QC) samples will be collected. Methods will follow those specified by Geraghty & Miller (ref. #9, appendix D). QA/QC samples collected during the field activities will include:

- One duplicate per 10 investigative samples.
- One field blank per week (laboratory-grade water poured through the air into VOC containers) during the sampling activities (Method 8240).
- One rinsate sample per week from the decontaminated polyethylene bailer during the field activities (Method 8240).
- One trip blank per shipment of VOC samples to the laboratory (Method 8240).

4.6 Equipment Maintenance

Field instrumentation will include a minimum of the following:

- A photoionization detector (PID), HNu model PI-101 or equivalent, equipped with a 10.2 eV lamp
- A combustible gas indicator (CGI)
- A oil/water level measurement probe
- A pH/conductivity/temperature probe

Instruments used as part of this investigation will be calibrated and operated in accordance with the procedures outlined in the Geraghty & Miller Work Plan (ref. #11, appendix A).

4.7 Waste Handling

Wastes (i.e., soil cuttings and development fluids) generated during the field activities will be temporarily containerized in 55-gallon drums, or in a holding tank, and will be sampled to determine if on-site remediation is necessary prior to discharge or disposal of these wastes.

4.8 Well Location Survey

A licensed land surveying firm will establish ground elevations and northing and easting coordinates for the soil borings and monitor wells with respect to the local Coordinate System. Top of casing elevations will also be determined for the monitor wells.

5.0 Quality Assurance and Quality Control

The objective of the quality assurance program is to ensure that the procedures for sampling and analytical testing provide data of known quality. The quality assurance program consists of three parts. These include a sampling quality assurance/quality control (QA/QC) program, an analytical Quality Assurance Project Plan (QAPP), and an independent data validation. Elements of this program are discussed in detail in the Geraghty & Miller Sampling, Analysis, and Monitoring Plan; the Quality Assurance Project Plan; and the Tutu Service Station Investigation Work Plan (refs. #9, #10, and #11) developed for the site. These documents will provide guidelines to be followed and fulfill all aspects of the quality assurance program.

6.0 Report Preparation

A summary report will be written describing the results and interpretations of data arising from the Phase I investigation. A final, detailed written report will be prepared after the entire scope of work described in this work plan has been completed. The final report will include a brief description of site geology and hydrology, the investigation objectives, investigation procedures, data obtained, data documentation, and an interpretation and discussion of the results. The following information will be presented on maps; monitor well surveyed locations, geologic cross-sections, and groundwater elevation contours.

Pertinent water-level, aquifer hydraulic properties, soil quality, and groundwater quality data will be summarized in tables. In addition, a set of appendices will be submitted that contain the raw analytical data, data validation report, and the raw field data (i.e., water-level measurements, and boring and monitor well installation logs). The report will be completed and submitted to the USEPA after receipt and independent validation of all the laboratory analytical data has been performed.

7.0 Project Schedule

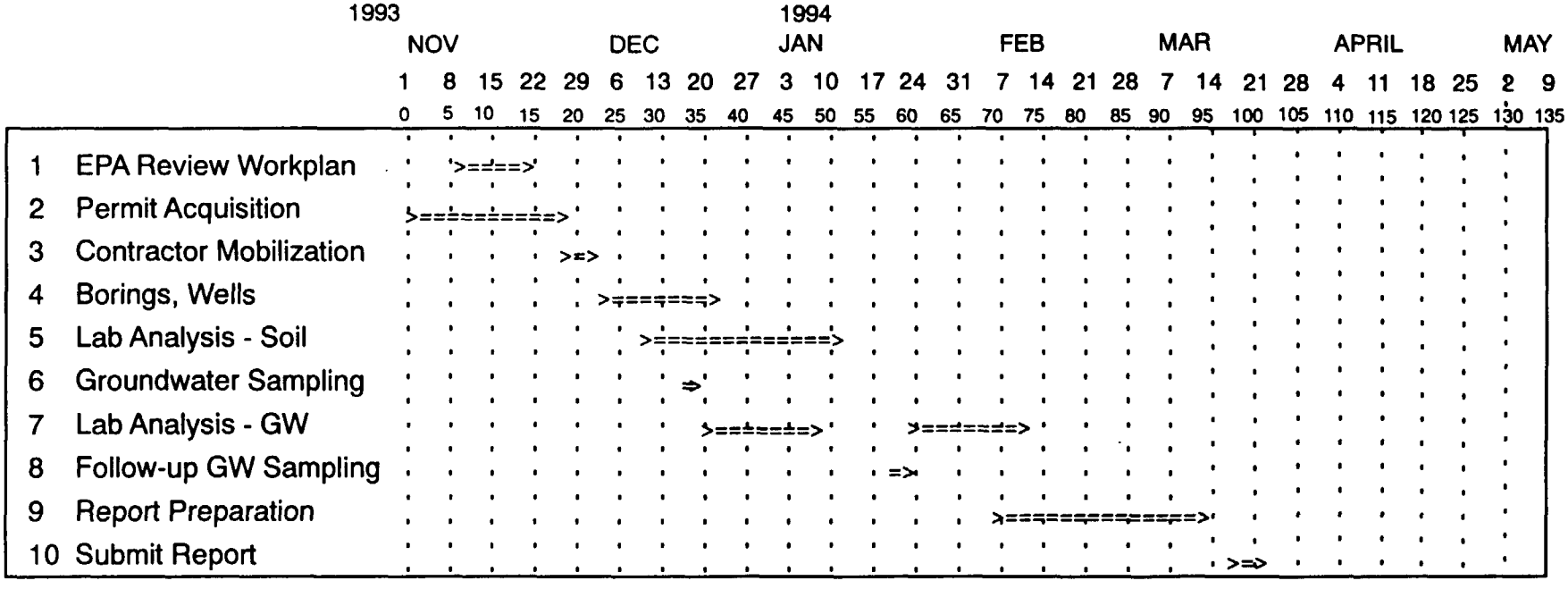
It is anticipated that the proposed work program can be implemented in accordance with the tentative schedule outlined in figure 10. Reasonable efforts will be made to achieve this tentative schedule and, under certain circumstances, some tasks may be expedited. It is important to note that the schedule is initiated at the point in time that EPA approval of the work scope is obtained.

Proposed Project Schedule

Figure 10

Gantt Chart Report - Current Date: 09-27-93

Texaco Tutu Station



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